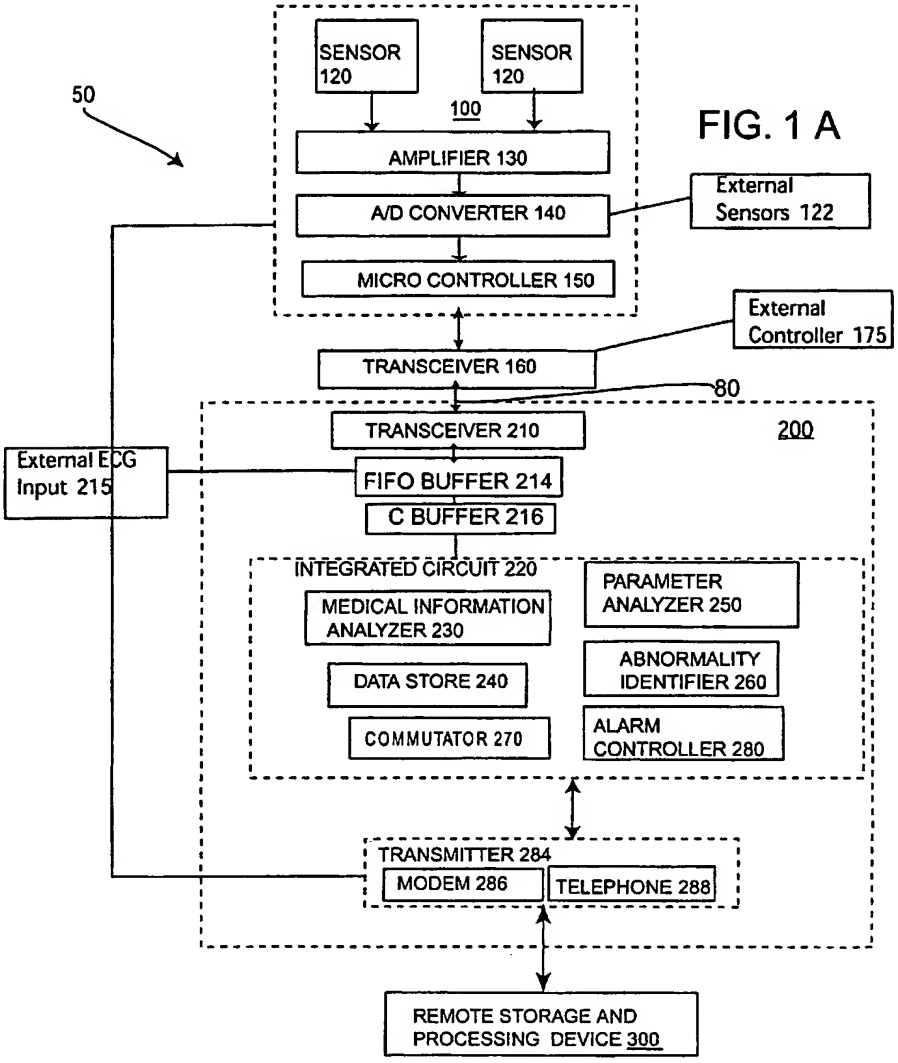
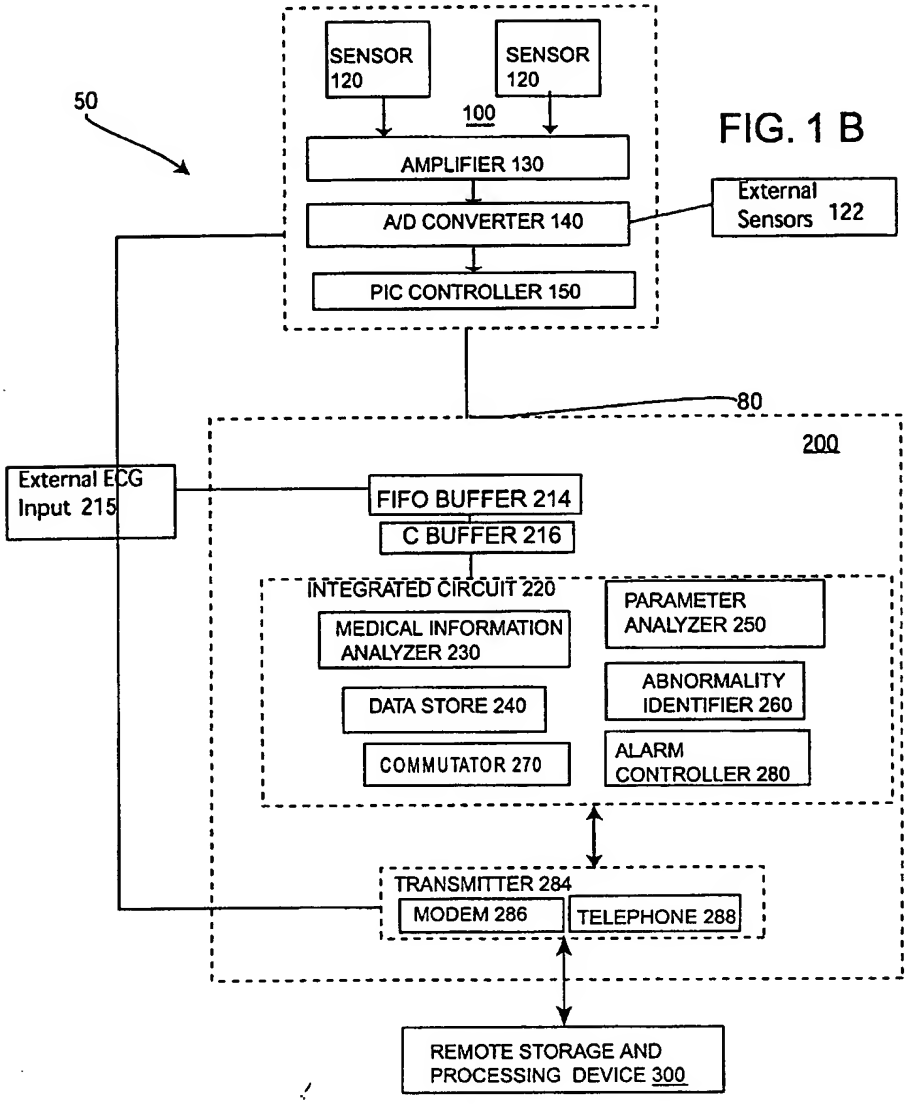

50
SENSOR 120
SENSOR 120
100
AMPLIFIER 130
A/D CONVERTER 140
External Sensors 122
MICRO CONTROLLER 150
External Controller 175
TRANSCEIVER 160
80
TRANSCEIVER 210
200
External ECG Input 215
FIFO BUFFER 214
C BUFFER 216
INTEGRATED CIRCUIT 220
PARAMETER ANALYZER 250
MEDICAL INFORMATION ANALYZER 230
ABNORMALITY IDENTIFIER 260
DATA STORE 240
ALARM CONTROLLER 280
COMMUTATOR 270
TRANSMITTER 284
MODEM 286
TELEPHONE 288
REMOTE STORAGE AND PROCESSING DEVICE 300

FIG. 1 A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SENSOR 120
SENSOR 120
100
AMPLIFIER 130
A/D CONVERTER 140
PIC CONTROLLER 150
External Sensors 122
80
200
External ECG Input 215
FIFO BUFFER 214
C BUFFER 216
INTEGRATED CIRCUIT 220
MEDICAL INFORMATION ANALYZER 230
DATA STORE 240
COMMUTATOR 270
PARAMETER ANALYZER 250
ABNORMALITY IDENTIFIER 260
ALARM CONTROLLER 280
TRANSMITTER 284
MODEM 286
TELEPHONE 288
REMOTE STORAGE AND PROCESSING DEVICE 300

FIG. 1 B

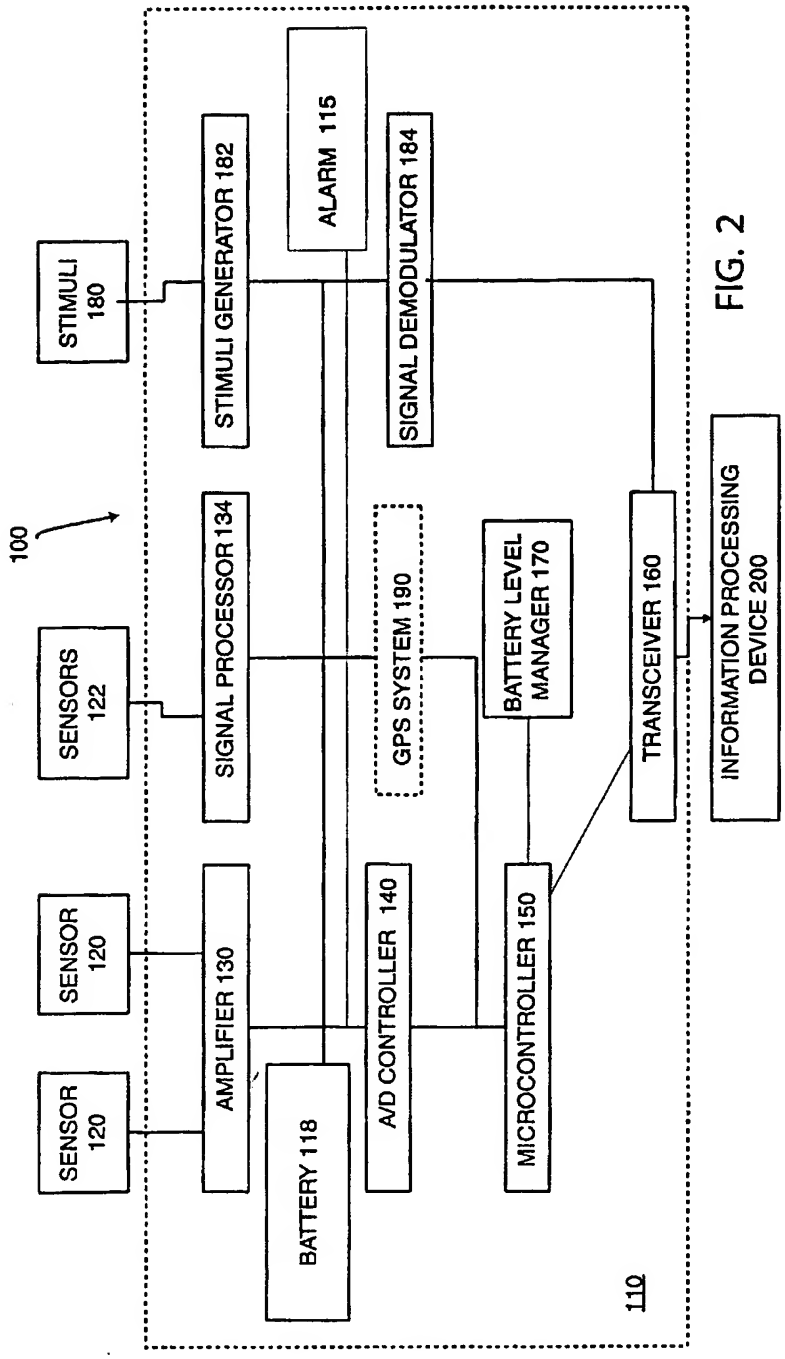

100
STIMULI 180
SENSORS 122
SENSOR 120
SENSOR 120
STIMULI GENERATOR 182
SIGNAL PROCESSOR 134
AMPLIFIER 130
BATTERY 118
ALARM 115
SIGNAL DEMODULATOR 184
GPS SYSTEM 190
A/D CONTROLLER 140
BATTERY LEVEL MANAGER 170
MICROCONTROLLER 150
TRANSCEIVER 160
INFORMATION PROCESSING DEVICE 200
110

FIG. 2

FIG. 3

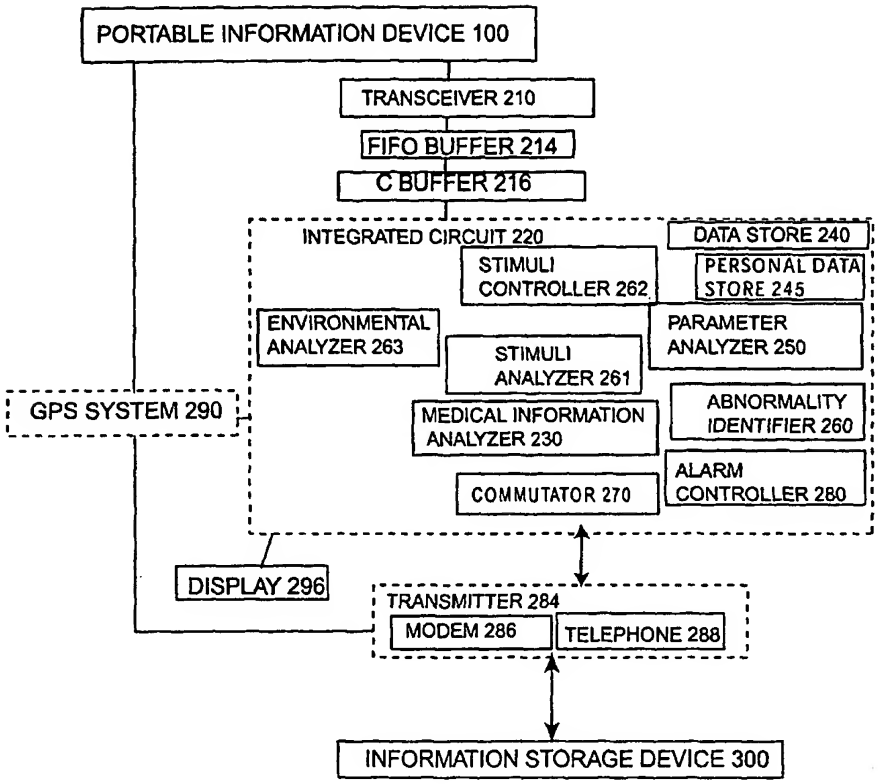

PORTABLE INFORMATION DEVICE 100
TRANSCEIVER 210
FIFO BUFFER 214
C BUFFER 216
INTEGRATED CIRCUIT 220
DATA STORE 240
STIMULI CONTROLLER 262
PERSONAL DATA STORE 245
ENVIRONMENTAL ANALYZER 263
PARAMETER ANALYZER 250
STIMULI ANALYZER 261
GPS SYSTEM 290
MEDICAL INFORMATION ANALYZER 230
ABNORMALITY IDENTIFIER 260
COMMUTATOR 270
ALARM CONTROLLER 280
DISPLAY 296
TRANSMITTER 284
MODEM 286
TELEPHONE 288
INFORMATION STORAGE DEVICE 300

FIG. 4

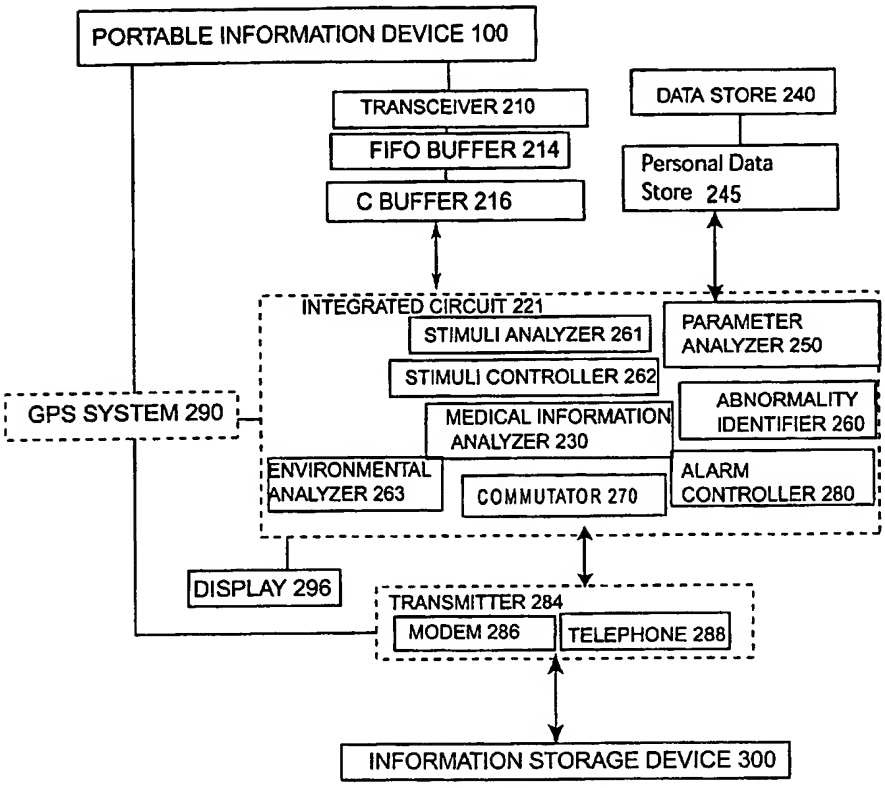
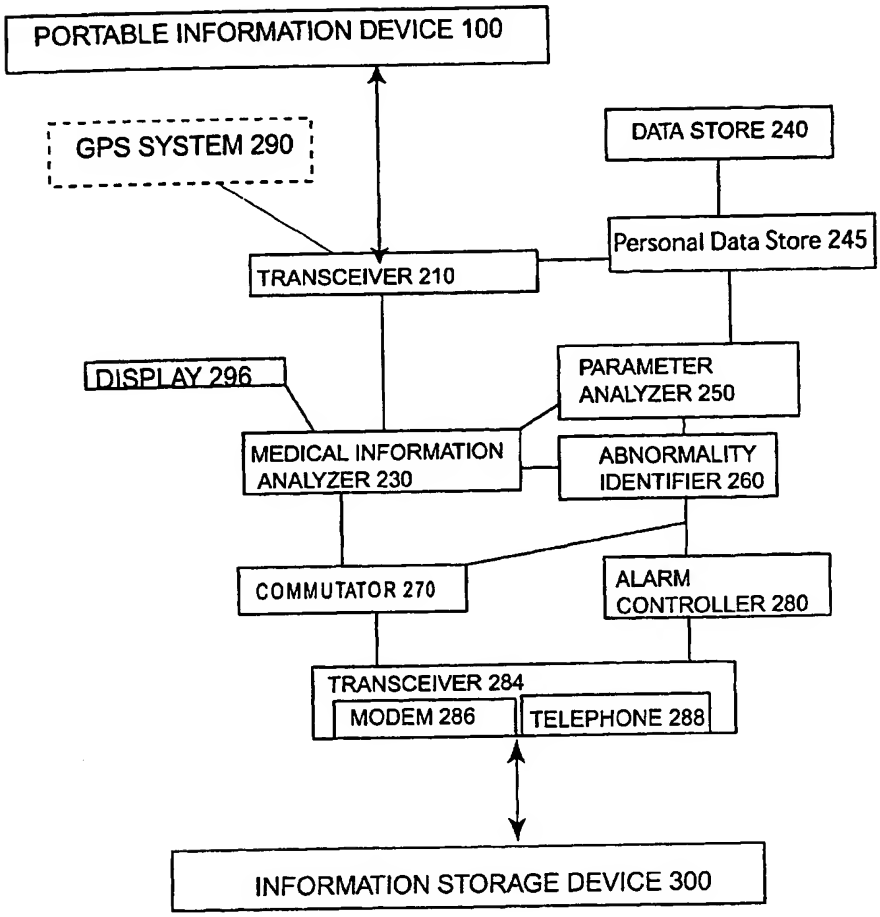

PORTABLE INFORMATION DEVICE 100
TRANSCEIVER 210
FIFO BUFFER 214
C BUFFER 216
DATA STORE 240
Personal Data Store 245
INTEGRATED CIRCUIT 221
STIMULI ANALYZER 261
PARAMETER ANALYZER 250
STIMULI CONTROLLER 262
ABNORMALITY IDENTIFIER 260
MEDICAL INFORMATION ANALYZER 230
GPS SYSTEM 290
ENVIRONMENTAL ANALYZER 263
COMMUTATOR 270
ALARM CONTROLLER 280
DISPLAY 296
TRANSMITTER 284
MODEM 286
TELEPHONE 288
INFORMATION STORAGE DEVICE 300

FIG. 5


PORTABLE INFORMATION DEVICE 100
GPS SYSTEM 290
DATA STORE 240
Personal Data Store 245
TRANSCEIVER 210
DISPLAY 296
PARAMETER ANALYZER 250
MEDICAL INFORMATION ANALYZER 230
ABNORMALITY IDENTIFIER 260
COMMUTATOR 270
ALARM CONTROLLER 280
TRANSCEIVER 284
MODEM 286
TELEPHONE 288
INFORMATION STORAGE DEVICE 300

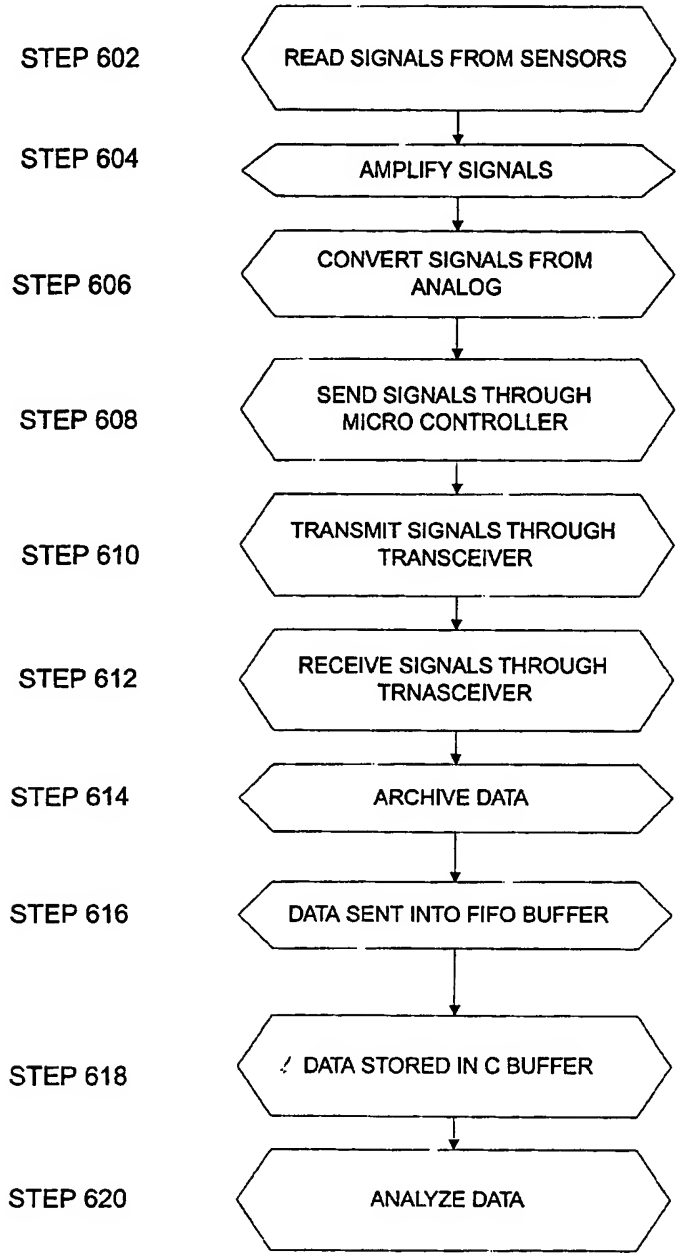

STEP 602
READ SIGNALS FROM SENSORS
STEP 604
AMPLIFY SIGNALS
STEP 606
CONVERT SIGNALS FROM ANALOG
STEP 608
SEND SIGNALS THROUGH MICRO CONTROLLER
STEP 610
TRANSMIT SIGNALS THROUGH TRANSCEIVER
STEP 612
RECEIVE SIGNALS THROUGH TRNASCEIVER
STEP 614
ARCHIVE DATA
STEP 616
DATA SENT INTO FIFO BUFFER
STEP 618
DATA STORED IN C BUFFER
STEP 620
ANALYZE DATA

FIG. 6

FIG. 7A

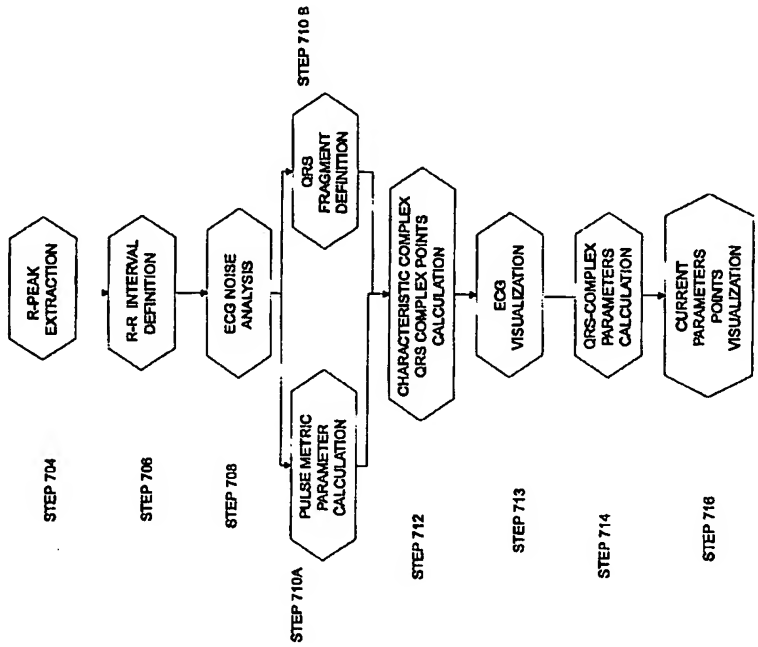

R-PEAK EXTRACTION
STEP 704
R-R INTERVAL DEFINITION
STEP 706
ECG NOISE ANALYSIS
STEP 708
PULSE METRIC PARAMETER CALCULATION
STEP 710A
QRS FRAGMENT DEFINITION
STEP 710 B
CHARACTERISTIC COMPLEX QRS COMPLEX POINTS CALCULATION
STEP 712
ECG VISUALIZATION
STEP 713
QRS-COMPLEX PARAMETERS CALCULATION
STEP 714
CURRENT PARAMETERS POINTS VISUALIZATION
STEP 716

FIG. 7B

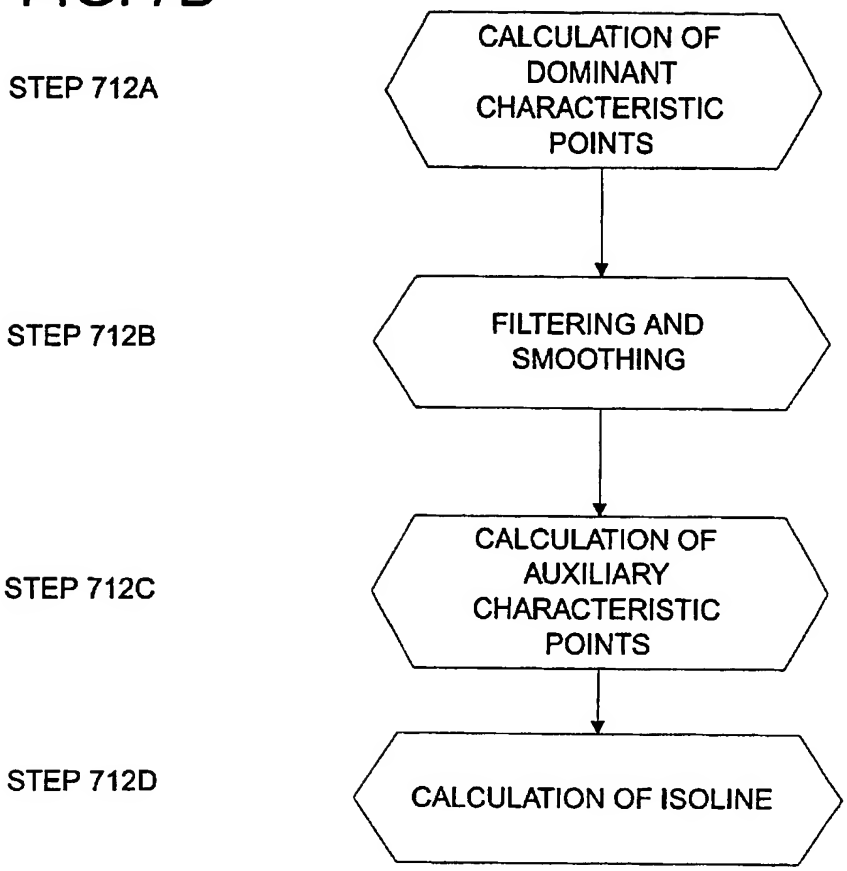

STEP 712A
CALCULATION OF DOMINANT CHARACTERISTIC POINTS
STEP 712B
FILTERING AND SMOOTHING
STEP 712C
CALCULATION OF AUXILIARY CHARACTERISTIC POINTS
STEP 712D
CALCULATION OF ISOLINE

FIG. 8A

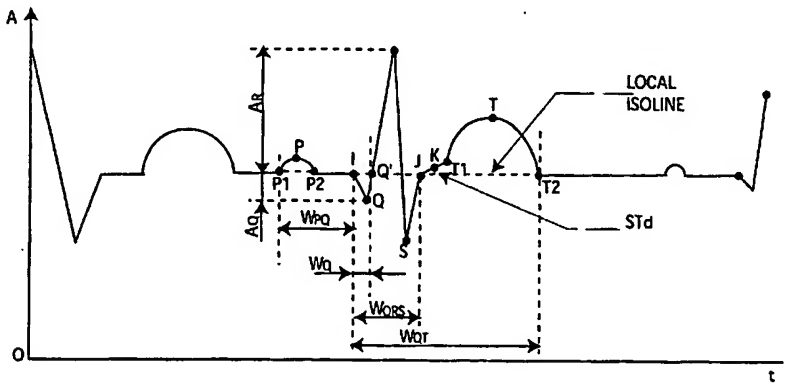
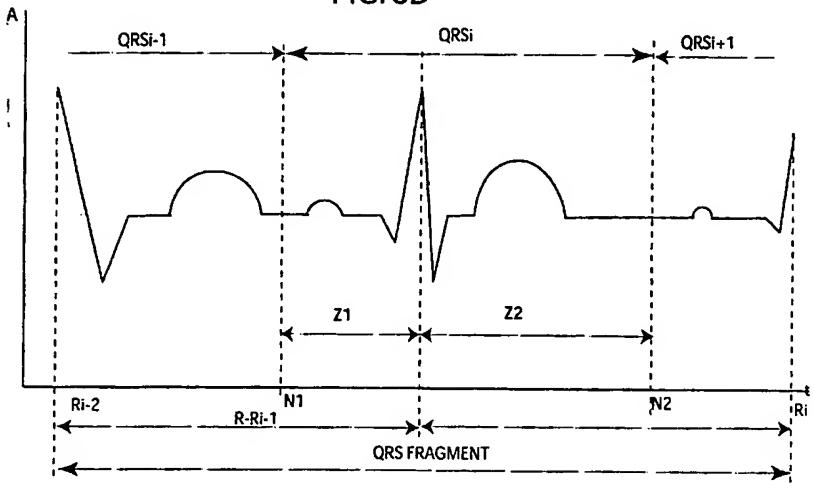

A
O
t
AR
P
P1
P2
I
Q'
Q
J
K
T
T1
T2
S
LOCAL
ISOLINE
STd
AQ
WPQ
WQ
WQRS
WQT

FIG. 8B


A
QRSi-1
QRSi
QRSi+1
Z1
Z2
Ri-2
N1
N2
Ri
R-Ri-1
QRS FRAGMENT

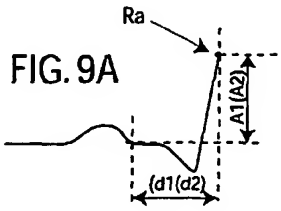


FIG. 9A

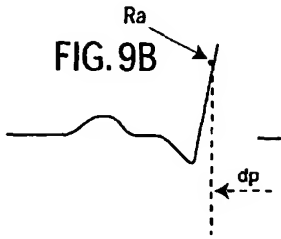


FIG. 9B

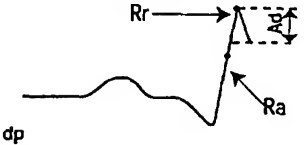


FIG. 9C

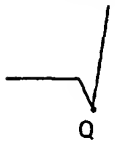


FIG. 10A

FIG. 10B

FIG. 10C

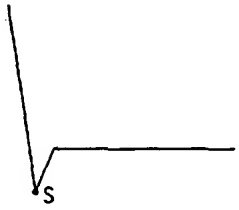


FIG. 11A

FIG. 11B

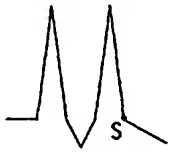


FIG. 11C

FIG. 12A

FIG. 12B

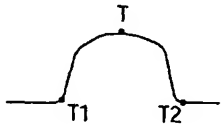


FIG. 12C

FIG. 13

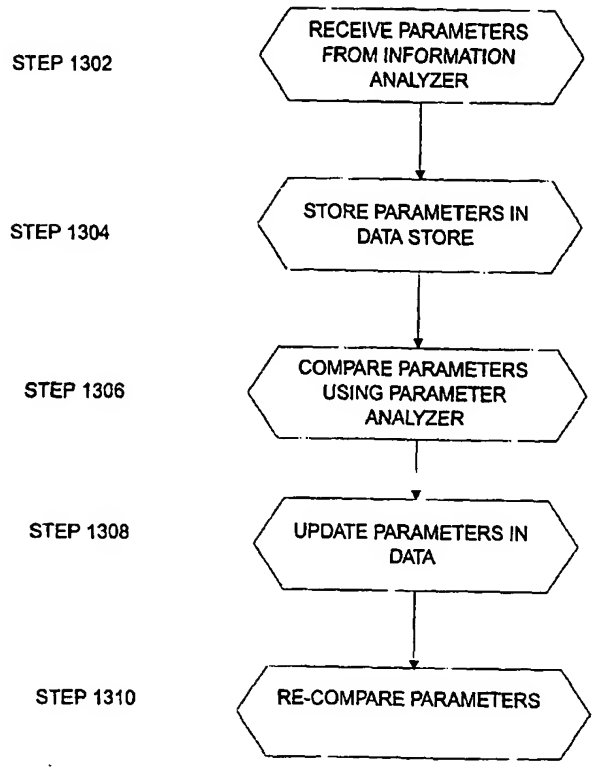

STEP 1302
RECEIVE PARAMETERS FROM INFORMATION ANALYZER
STEP 1304
STORE PARAMETERS IN DATA STORE
STEP 1306
COMPARE PARAMETERS USING PARAMETER ANALYZER
STEP 1308
UPDATE PARAMETERS IN DATA
STEP 1310
RE-COMPARE PARAMETERS

FIG. 14

Parametric value	*Description*
Pulse rate	Defined as average value of R-R- Interval of 4 last R-R-Intervals per 1 minute
Immediate alteration of pulse rate	Defined as difference between Pulse Rate calculated for the last 4 R-R- Intervals and Pulse Rate calculated for previous 4 R-R- Intervals (i = N-7,..,N-4): $P_a = P_N - P_{N-3}$
RR-Interval	Defined as a distance between 2 consecutive R-Peak (ms)
Premature beats	The number of extrasystoles within last 10 seconds.
Group of premature beats	The number of consecutive extrasystoles
The atrial fibrillation-flutter	F = (F1 + F2) * X (%), where: F1 – Extrasystole factor and F2 – Variability factor for the last 15 RR intervals
ST-Segment depression/elevation	Defined as a distance (mm) between point K and isoline of QRS-complex. Its value is averaged for last 10 QRS-complexes
T-wave inversion	Inversion of current T-peak is identified within localization of point T. Cardiac event "T-wave Inversion" is occurred if 4 consecutive inverse T-peak are received
Width of Q-wave	Distance between point I and Q' in ms
Ratio of amplitude Q-wave to amplitude R-wave	$A_{QR} = \frac{A_I - A_Q}{A_R - A_I} \cdot 100\%$ A_{QR} value is averaged for the last 5 QRS-complexes
Amplitude of R-wave	Defined as difference between absolute values of point R amplitude and point I amplitude: $A_{Rd} = (A_R - A_I) \cdot 0.2$ (mm) A_{Rd} value is averaged for the last 5 QRS-complexes
Width of QT-interval	Defined as distance (ms) between point I of beginning of Q-peak and point T2-peak of the end of T-peak
Width of QRS-complex	Defined as the distance (ms) between point I and point J
Width of PQ-interval	W_{PQ} is defined as the distance (ms) between point P1 of beginning of P-peak and point I. W_{PQ} value is averaged for the last 5 QRS-complexes
Standard deviation of the average normal-to-normal R-R intervals	Sinus node depolarization calculated over a period of 5 min

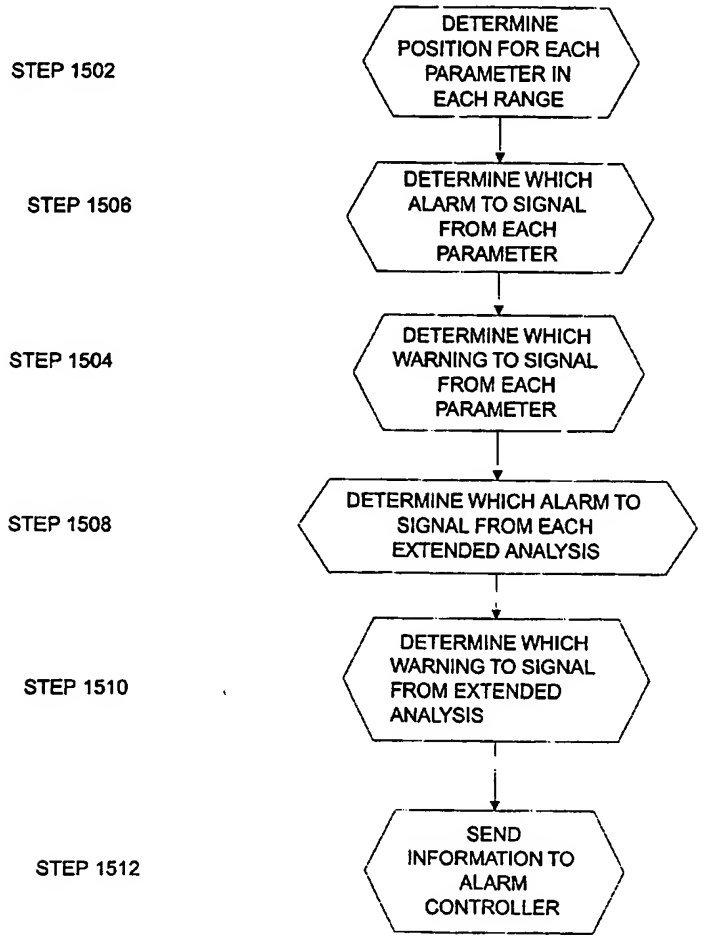

STEP 1502
DETERMINE POSITION FOR EACH PARAMETER IN EACH RANGE
STEP 1506
DETERMINE WHICH ALARM TO SIGNAL FROM EACH PARAMETER
STEP 1504
DETERMINE WHICH WARNING TO SIGNAL FROM EACH PARAMETER
STEP 1508
DETERMINE WHICH ALARM TO SIGNAL FROM EACH EXTENDED ANALYSIS
STEP 1510
DETERMINE WHICH WARNING TO SIGNAL FROM EXTENDED ANALYSIS
STEP 1512
SEND INFORMATION TO ALARM CONTROLLER

FIG. 15

FIG. 16a. Typical threshold parameters values

Warning	Alarm	Description
W_1	A_1	Pulse rate less than 50/40 bpm (during 4 QRS complexes)
W_2	A_2	Pulse rate more than 140/160 bpm (during 4 QRS complexes)
	A_3	Immediate alteration of pulse rate up, more than 40 bpm (during 4 QRS complexes)
	A_4	Immediate alteration of pulse rate down, more than 40 bpm (during 4 QRS complexes)
	A_5	R-R interval more than 2.5 sec
	A_6	Premature beats, repeated more then 1 in 10 sec
	A_7	2 consecutive premature beats
W_8	A_8	The atrial fibrillation-flutter > 20/30 %
W_9	A_9	ST-segment depression > 1.0/1.5 mm, measured at 80 ms from J-point
W_{10}	A_{10}	ST-segment elevation > 1.5/2.0 mm, measured at 80 ms from J-point
	A_{11}	T wave inversion = 1
W_{12}	A_{12}	Increase of Q wave > 30/40 ms
W_{13}	A_{13}	Increase of Q/R amplitude ratio > 20/30 %
W_{14}	A_{14}	Decreases of R-wave amplitude > 30/50 %
W_{15}	A_{15}	Increase of QT interval > 450/500 ms
	A_{16}	Sudden increase of QT interval > 30 % from preceded
W_{17}	A_{17}	Increase of QRS duration > 110/120 ms
W_{18}	A_{18}	Increase of PQ interval > 180/200 ms
	GE_{A7}	Consecutive premature beats > 2
ST_{W9}	ST_{A9}	ST-segment depression > 1.5/2.0 mm, measured at 80 ms from J-point
ST_{W10}	ST_{A10}	ST-segment elevation > 2.0/2.5 mm, measured at 80 ms from J-point
W_G	A_G	Integrated Relative Risk of SCD or development of Myocardial Infarction > 1.8/2.5

FIG. 16b. Pulse-metric parameters

Warning	Alarm	Description
W_1	A_1	Pulse rate less than $A_1(W_1)$ bpm (during 4 QRS complexes)
W_2	A_2	Pulse rate more than $A_2(W_2)$ bpm (during 4 QRS complexes)
	A_3	Immediate alteration of pulse rate up, more than A_3 bpm (during 4 QRS complexes)
	A_4	Immediate alteration of pulse rate down, more than A_4 bpm (during 4 QRS complexes)
	A_5	R-R interval more than A_5 sec
	A_6	Premature beats, repeated more then A_6 in 10 sec
	A_7	A_7 consecutive premature beats
W_8	A_8	The atrial fibrillation-flutter > $A_8(W_8)$ %

FIG. 16c. QRS parameters

Warning	Alarm	Description
W_9	A_9	ST-segment depression > $A_9(W_9)$ mm, measured at 80 ms from J-point
W_{10}	A_{10}	ST-segment elevation > $A_{10}(W_{10})$ mm, measured at 80 ms from J-point
	A_{11}	T wave inversion = A_{11}
W_{12}	A_{12}	Increase of Q wave > $A_{12}(W_{12})$ ms
W_{13}	A_{13}	Increase of Q/R amplitude ratio > $A_{13}(W_{13})$ %
W_{14}	A_{14}	Decreases of R-wave amplitude > $A_{14}(W_{14})$ %
W_{15}	A_{15}	Increase of QT interval > $A_{15}(W_{15})$ ms
	A_{16}	Sudden Increase of QT interval > A_{16} % from preceded
W_{17}	A_{17}	Increase of QRS duration > $A_{17}(W_{17})$ ms
W_{18}	A_{18}	Increase of PQ interval > $A_{18}(W_{18})$ ms

FIG. 16d. Extended pulse-metric parameters

Warning	Alarm	Description
	GE_{A7}	Consecutive premature beats > GE_{A7}

FIG. 16e. Extended QRS parameters

Warning	Alarm	Description
ST_{W9}	ST_{A9}	ST-segment depression > ST_{A9} mm, measured at 80 ms from J-point
ST_{W10}	ST_{A10}	ST-segment elevation > ST_{A10} mm, measured at 80 ms from J-point

FIG. 16f. Integrated parameters

Warning	Alarm	Description
W_G	A_G	Integrated Relative Risk of SCD or development of Myocardial Infarction > A_G

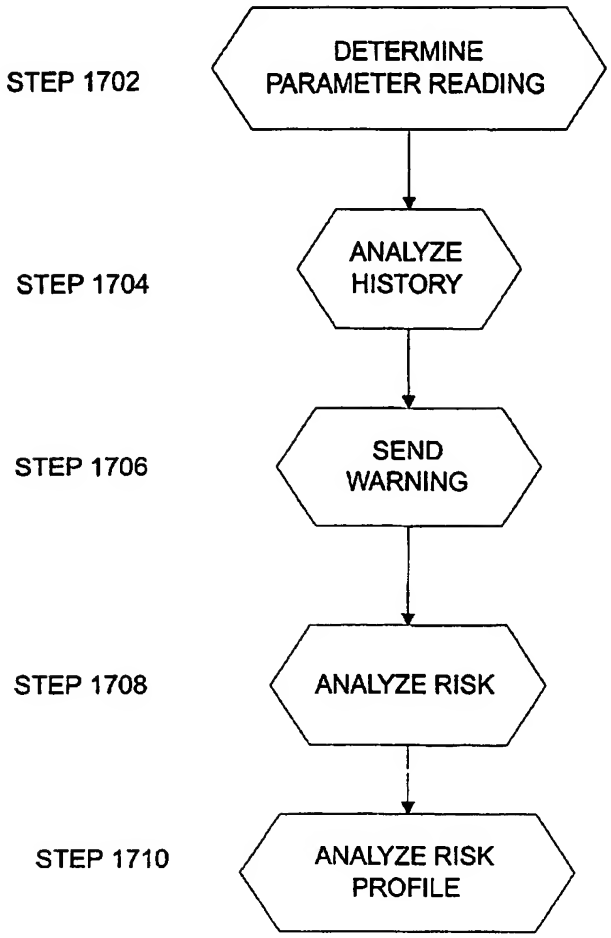

STEP 1702
DETERMINE PARAMETER READING
STEP 1704
ANALYZE HISTORY
STEP 1706
SEND WARNING
STEP 1708
ANALYZE RISK
STEP 1710
ANALYZE RISK PROFILE

FIG. 17

FIG. 18

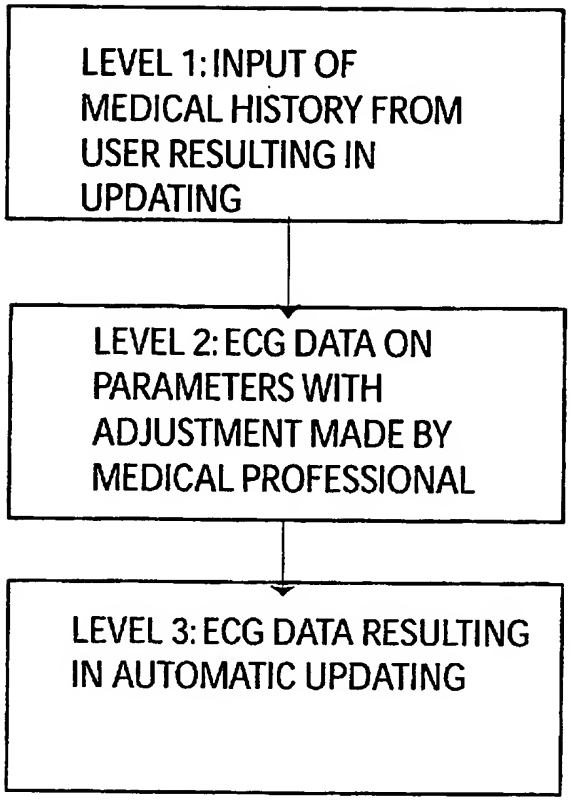
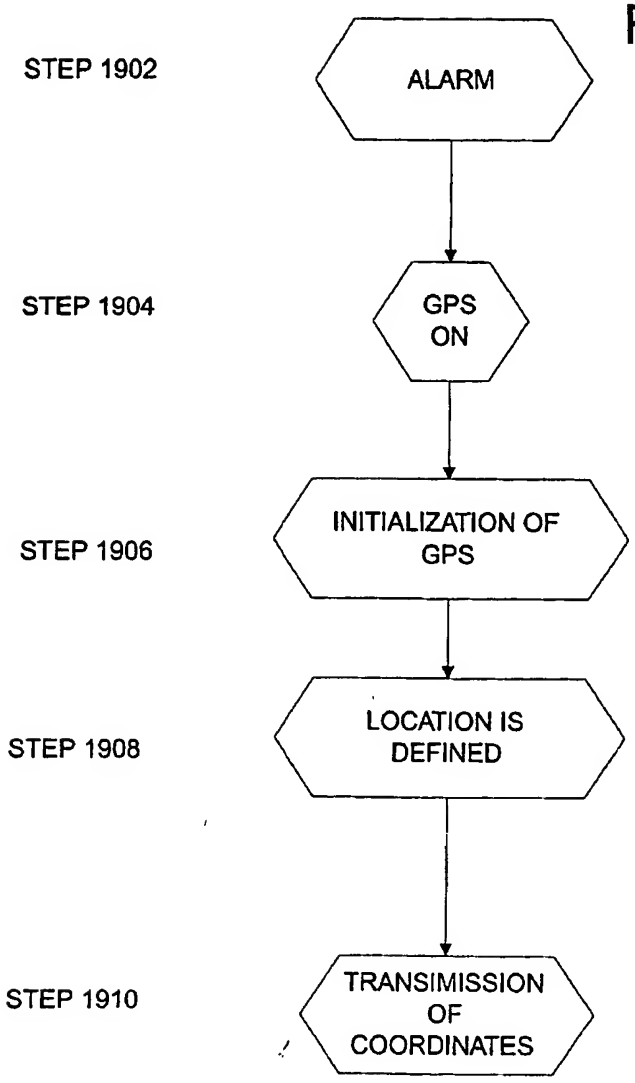

LEVEL 1: INPUT OF MEDICAL HISTORY FROM USER RESULTING IN UPDATING
LEVEL 2: ECG DATA ON PARAMETERS WITH ADJUSTMENT MADE BY MEDICAL PROFESSIONAL
LEVEL 3: ECG DATA RESULTING IN AUTOMATIC UPDATING

FIG. 19


STEP 1902
ALARM
STEP 1904
GPS ON
STEP 1906
INITIALIZATION OF GPS
STEP 1908
LOCATION IS DEFINED
STEP 1910
TRANSIMISSION OF COORDINATES